JOB SHEET 42

Inspecting and Cleaning the Battery Cables and Connections

Name: _____ Station: _____ Date: _____

NATEF Correlation

This Job Sheet addresses the following NATEF task(s):

6.B.4 Inspect, clean, fill, and/or replace battery, battery cables, connectors, clamps, and holddowns. (P-1)

Performance Objective(s)

Upon completion of this Job Sheet, you will be able to understand how to inspect, clean, remove, and install a battery, the cables, and holddown apparatus.

Tools and Materials

Voltmeter
Battery terminal cleaner/brush
Service manual
Technician's tool set
Vehicle
Baking soda or battery cleaning solution
Battery terminal remover
Wire brush

Protective Clothing/Equipment

Goggles or safety glasses with side shields

Describe the vehicle being worked on:

Year	Make	Model	VIN	Engine type and size

PROCEDURE

1. Describe the general appearance of the battery.

_____

_____

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

2. Describe the general appearance of the battery terminals and cables.

_____

_____

3. Check the tightness of the battery cables. Are they tight?

_____

4. With the ignition in the on position, use the voltmeter to measure the amount of voltage drop from the battery positive terminal to the battery positive cable (while it is still attached).

_____

5. Do your answers from steps 3 and 4 indicate that there might be a problem?

_____

6. Describe the condition of the battery holddown.

_____

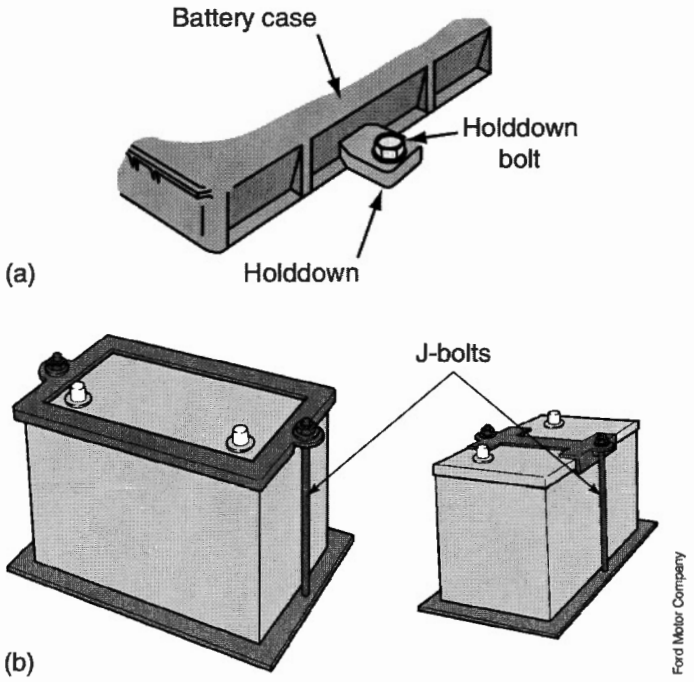


Figure 26.21 Different types of battery hold-downs.

7. Turn the key off and remove the battery cables and holddown apparatus.

Note: *You may have to use the battery terminal remover to remove some stuck cables.*

Task Completed _____

8. Remove the battery and place it on a bench.

Task Completed _____

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

9. Describe the condition of the battery tray.

_____

10. Using the wire brush, a baking soda and water solution, or a battery terminal cleaning solution, clean the battery cables, holddown, and tray.

Task Completed _____

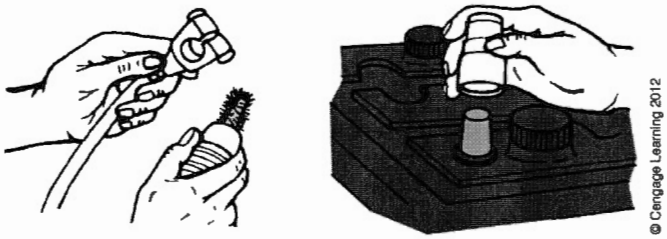

© Cengage Learning 2012

Figure 27.4 A battery terminal cleaner that cleans both the inside of the clamp and the outside of the post.

11. After cleaning, inspect the battery cables. Do they still have corrosion on them?

_____

12. If the battery has removable caps on it, remove them and check the fluid level.

Warning: *Do not use a flame light to look inside the battery. Use a flashlight. Batteries emit hydrogen gas, which is explosive!*

Task Completed _____

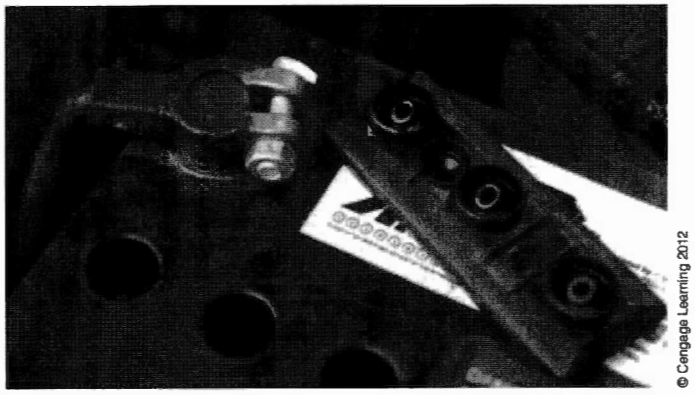

© Cengage Learning 2012

Figure 26.8 This battery has removable cell caps.

13. Fill the battery with clean, distilled water (do not use tap water and do not overfill).

Task Completed _____

14. Reinstall the battery, cables, and holddown.

Task Completed _____

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

Problems Encountered

_____

_____

_____

INSTRUCTOR EVALUATION

- ☐ 4 Mastered Task
- ☐ 3 Able to Perform Task Independently; Some Additional Training Suggested
- ☐ 2 Able to Perform Task with Close Supervision; Requires Additional Training
- ☐ 1 Unable to Perform Task
- ☐ 0 Not Attempted

Comments

_____

_____

Instructor Name: _____ Date: _____

Instructor Signature: _____

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

JOB SHEET 43

Perform a State-of-Charge Battery Test

Name: _____ Station: _____ Date: _____

NATEF Correlation

This Job Sheet addresses the following NATEF task(s):

6.B.1 Perform battery state-of-charge test; determine necessary action. (P-1)

Performance Objective(s)

Upon completion of this Job Sheet, you will be able to understand how to perform a battery state-of-charge test.

Tools and Materials

Voltmeter
Service manual
Hydrometer or refractometer
Technician's tool set
Battery with removable caps
Infrared temperature gun

Protective Clothing/Equipment

Goggles or safety glasses with side shields

Describe the vehicle being worked on:

Year	Make	Model	VIN	Engine type and size

PROCEDURE

1. Remove the battery caps and check the fluid level.

Warning: *Do not use a flame light to look inside the battery. Use a flashlight. Batteries emit hydrogen gas, which is explosive!*

Task Completed _____

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

2. Does the battery have a built-in hydrometer? If yes, describe what you see in the sight glass.

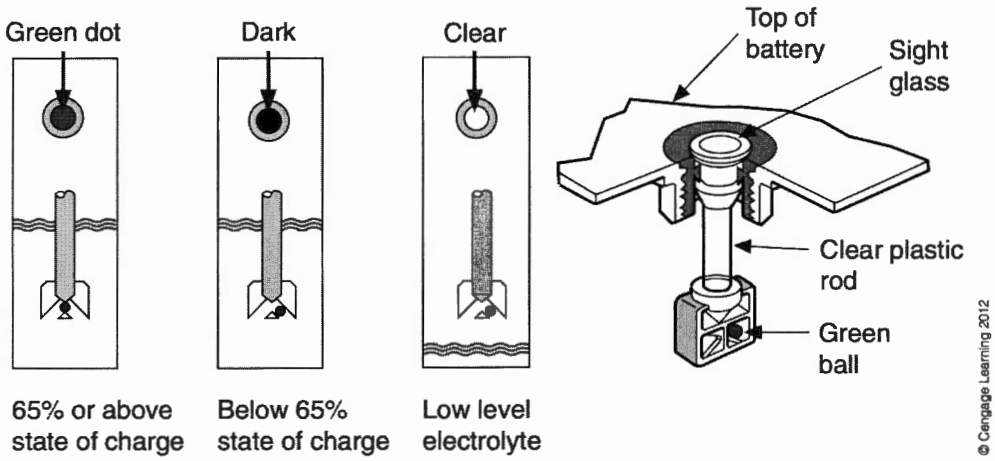


Figure 27.27 A built-in hydrometer in a sealed battery indicates the condition of the battery.

3. What is the temperature of the battery case?

4. Measure the specific gravity of each cell using the hydrometer or refractometer and record it below.

Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6

Figure 27.24 Draw electrolyte into the hydrometer.

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

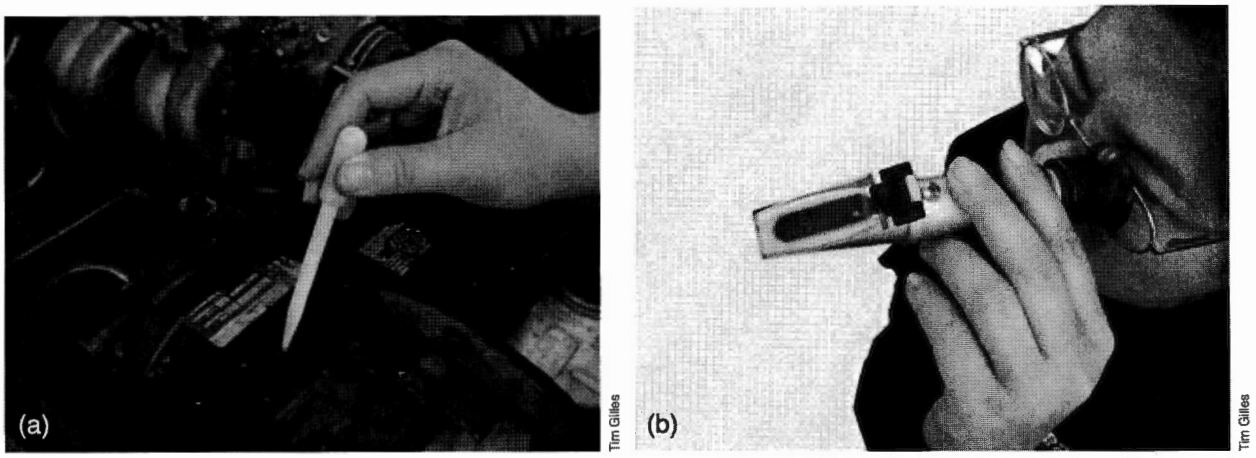


Figure 27.30 (a) Removing an electrolyte sample from the battery. (b) Reading the strength of the sample with the refractometer.

5. With respect to the temperature, list the corrected specific gravity of each cell.

Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6

6. Fill the battery with clean, distilled water (do not use tap water and do not overfill).

Task Completed _____

7. What is the open circuit voltage of the battery?

_____

8. Do your corrected specific gravity readings correlate to the open circuit voltage?

_____

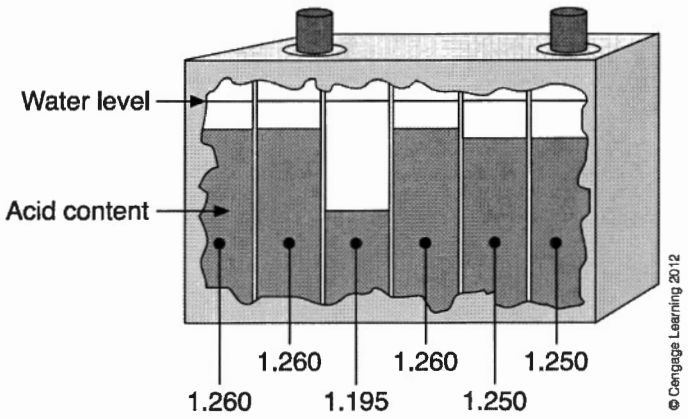


Figure 27.26 Hydrometer readings should vary no more than 0.050. This battery has a defective cell.

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

9. Based on your testing, does the battery require replacement or recharging?

_____

_____

Problems Encountered

_____

_____

_____

INSTRUCTOR EVALUATION

- ☐ 4 Mastered Task
- ☐ 3 Able to Perform Task Independently; Some Additional Training Suggested
- ☐ 2 Able to Perform Task with Close Supervision; Requires Additional Training
- ☐ 1 Unable to Perform Task
- ☐ 0 Not Attempted

Comments

_____

_____

Instructor Name: _____ Date: _____

Instructor Signature: _____

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

JOB SHEET 44

Charging a Battery

Name: _____ **Station:** _____ **Date:** _____

NATEF Correlation

This Job Sheet addresses the following NATEF task(s):

6.B.5 Perform battery charge. (P-1)

Performance Objective(s)

Upon completion of this Job Sheet, you will be able to understand how to perform a battery state-of-charge test.

Tools and Materials

Voltmeter
Service manual
Technician's tool set
Fender cover
Battery charger

Protective Clothing/Equipment

Goggles or safety glasses with side shields

Describe the vehicle being worked on:

Year	Make	Model	VIN	Engine type and size

PROCEDURE

1. Place the fender covers on the fender closest to the battery.

Task Completed _____

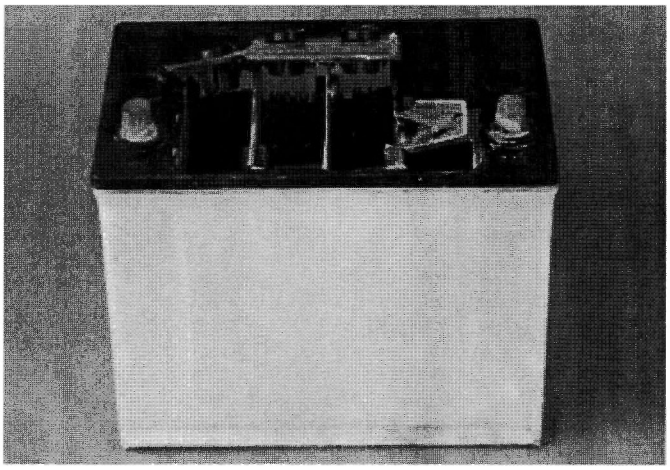
© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

2. If equipped, remove the battery caps and check the fluid level. Fill the battery with clean, distilled water (do not use tap water) if needed and reinstall the battery caps (do not overfill the battery).

Warning: *Do not charge the battery if the fluid inside is frozen!*

Note: *If the battery is a sealed design, use a noncontact thermometer or a temperature probe to get an indication if the battery is frozen.*

Task Completed _____



Tim Gilles

Figure 3.28 Careless use of the battery charger caused this battery to explode.

3. Remove the battery terminals and move the cables to the side.

Task Completed _____

4. What is the open circuit voltage of the battery?

_____

Tim Gilles

Figure 27.32 Reading open circuit voltage with a digital voltmeter.

5. Check that the charger is turned off and connect the battery charger cables to the battery.

Warning: *Be sure that you have a good connection so that you do not produce a spark. Batteries produce a hydrogen gas when charging.*

Task Completed _____

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

6. Turn the charger on to the setting for a slow charge. What is the amperage on this setting and how long would you leave it on?

_____

7. Turn the charger on to the setting for a fast charge. What is the amperage on this setting and how long would you leave it on?

_____

8. Explain the situations in which you would use a slow charge or a fast charge.

_____

_____

Problems Encountered

_____

_____

_____

INSTRUCTOR EVALUATION

- ☐ 4 Mastered Task
- ☐ 3 Able to Perform Task Independently; Some Additional Training Suggested
- ☐ 2 Able to Perform Task with Close Supervision; Requires Additional Training
- ☐ 1 Unable to Perform Task
- ☐ 0 Not Attempted

Comments

_____

_____

Instructor Name: _____ Date: _____

Instructor Signature: _____

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

JOB SHEET 45

Jump-Starting a Battery

Name: _____ **Station:** _____ **Date:** _____

NATEF Correlation

This Job Sheet addresses the following NATEF task(s):

6.B.6 Start a vehicle using jumper cables or an auxiliary power supply. (P-2)

Performance Objective(s)

Upon completion of this Job Sheet, you will be able to understand how to properly jump-start a vehicle using a live battery in a vehicle and an auxiliary power supply (booster pack).

Tools and Materials

Battery jumper cables
Vehicle with a live battery
Vehicle with a dead battery
Auxiliary power supply (booster pack)

Protective Clothing/Equipment

Goggles or safety glasses with side shields

Describe the vehicle being worked on:

Year	Make	Model	VIN	Engine type and size

PROCEDURE

1. What are the gauge size and length of the battery jumper cables you are using?

   _____

2. Position the vehicle with the live battery so that the jumper cables will not be stretched.

   Task Completed _____

3. Open the hood of both vehicles.

   Task Completed _____

4. Make sure that the ignition is in the off position on both vehicles.

   Task Completed _____

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

5. Connect one end of the positive jumper cable to the dead car's positive battery terminal.

Task Completed _____

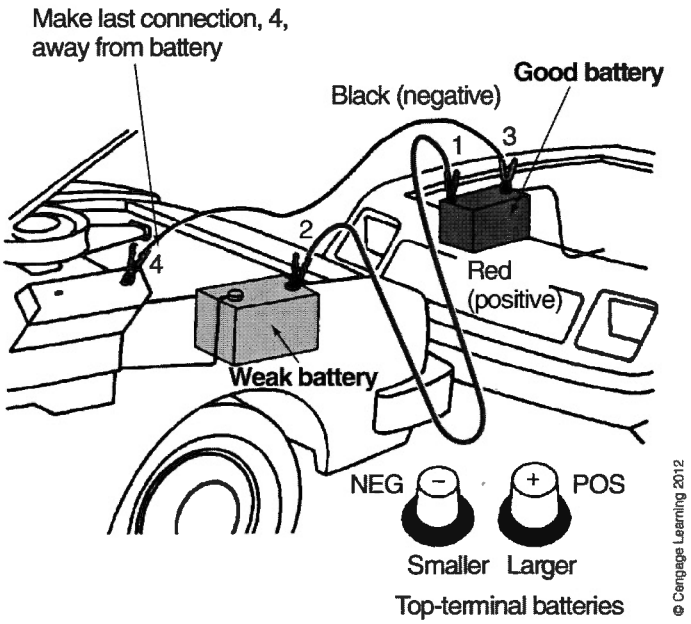


Figure 3.29 Correct connections for jump-starting a car.

6. Connect the other end of the positive jumper cable to the live car's positive battery terminal.

Task Completed _____

7. Connect one end of the negative jumper cable to the live car's negative battery terminal.

Task Completed _____

8. Connect the other end of the negative jumper cable to the dead car's engine ground.

Task Completed _____

9. Start the engine on the live car and wait a minute.

Task Completed _____

10. Attempt to start the dead car. Once the dead car starts, remove the negative jumper cable from the engine ground.

Task Completed _____

11. Remove the negative jumper cable from the live car.

Task Completed _____

12. Remove the positive jumper cable from the live car.

Task Completed _____

13. Remove the positive jumper cable from the dead car.

Task Completed _____

14. Now connect the auxiliary power supply (booster pack) to the dead vehicle's battery in the same manner as you did before, but skipping the "live car" steps.

Task Completed _____

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

15. If the auxiliary power supply (booster pack) has an on/off switch, turn it on now.

Task Completed _____

16. Start the engine of the dead car.

Task Completed _____

17. Turn the engine off and turn the switch on the auxiliary power supply (booster pack) off.

Task Completed _____

18. Remove the cables from the auxiliary power supply (booster pack) and remove it from the vehicle.

Task Completed _____

19. Explain what could possibly happen if you connected the dead car's battery jumper cables to both the positive and negative terminals.

_____

_____

Problems Encountered

_____

_____

_____

INSTRUCTOR EVALUATION

- ☐ 4 Mastered Task
- ☐ 3 Able to Perform Task Independently; Some Additional Training Suggested
- ☐ 2 Able to Perform Task with Close Supervision; Requires Additional Training
- ☐ 1 Unable to Perform Task
- ☐ 0 Not Attempted

Comments

_____

_____

Instructor Name: _____ Date: _____

Instructor Signature: _____

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

JOB SHEET 46

Perform a Battery Capacity and Conductance Test

Name: _____ **Station:** _____ **Date:** _____

NATEF Correlation

This Job Sheet addresses the following NATEF task(s):

6.B.2 Perform battery capacity test; confirm proper battery capacity for vehicle application; determine necessary action. (P-1)

6.A.2 Identify and interpret electrical/electronic system concern; determine necessary action. (P-1)

Performance Objective(s)

Upon completion of this Job Sheet, you will be able to understand how to perform a battery test using both the capacity and conductance methods.

Tools and Materials

Capacity (load) tester

Conductance tester

Protective Clothing/Equipment

Goggles or safety glasses with side shields

Describe the vehicle being worked on:

Year	Make	Model	VIN	Engine type and size

PROCEDURE

1. Explain the difference between a conductance test and a capacity test.

_____

_____

_____

_____

Note: *Steps 2–8 are for performing a capacity test.*

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

2. What is the battery CCA?

_____

3. What is the open circuit voltage of the battery?

_____

4. Does the battery require charging before testing?

_____

Note: *If the battery open circuit is less than 12.4 volts, recharge it before performing the capacity test.*

5. Connect the battery capacity tester clamps to the battery. Make sure they are on tight.

Task Completed _____

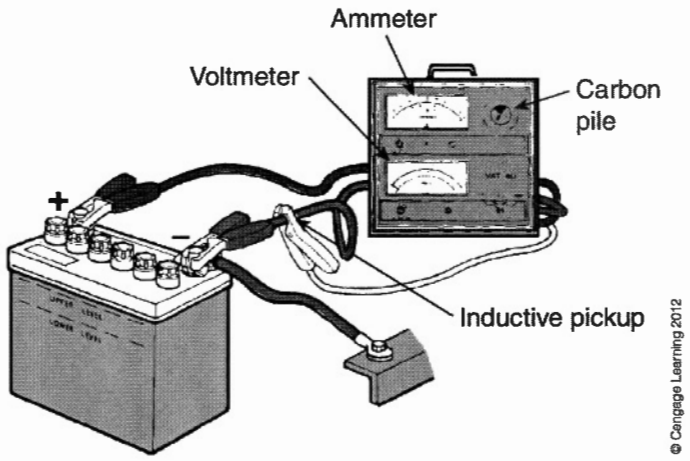


Figure 27.41 Parts of a volt-amp tester.

6. Based on the battery rating, how much load should be applied to the battery during the capacity test?

_____

7. Conduct the battery capacity load test.

Voltage dropped to _____ volts

Load was held for _____ seconds

8. Did the battery pass the capacity (load) test?

_____

9. Is there enough power (current capacity) to meet the minimum requirements for this vehicle?

_____

Note: *Steps 10–13 are for performing a conductance test.*

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

10. Connect the battery conductance tester to the battery terminals.

Task Completed _____

11. Follow the tester's instructions by entering the CCA into the tester screen.

Task Completed _____

12. Conduct the battery conductance test.

Task Completed _____

13. What were the results of the test?

_____

14. If this Job Sheet is for a live customer, do you think that this testing series provides sufficient information to determine the customer's problem? Why or why not?

_____

_____

Problems Encountered

_____

_____

_____

INSTRUCTOR EVALUATION

- ☐ 4 Mastered Task
- ☐ 3 Able to Perform Task Independently; Some Additional Training Suggested
- ☐ 2 Able to Perform Task with Close Supervision; Requires Additional Training
- ☐ 1 Unable to Perform Task
- ☐ 0 Not Attempted

Comments

_____

_____

Instructor Name: _____ Date: _____

Instructor Signature: _____

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

JOB SHEET 47

Battery Removal and Installation

Name: _____ Station: _____ Date: _____

NATEF Correlation

This Job Sheet addresses the following NATEF task(s):

6.B.3 Maintain or restore electronic memory functions. (P-1)

6.B.8 Identify electronic modules, security systems, radios, and other accessories that require reinitialization or code entry following battery disconnect. (P-1)

6.B.4 Inspect, clean, fill, and/or replace battery, battery cables, connectors, clamps, and holddowns. (P-1)

Performance Objective(s)

Upon completion of this Job Sheet, you will be able to understand how to remove and reinstall a battery and how to use a memory saving device.

Tools and Materials

Service manual
Technician's tool set
Vehicle
Memory saving device

Protective Clothing/Equipment

Goggles or safety glasses with side shields

Describe the vehicle being worked on:

Year	Make	Model	VIN	Engine type and size

PROCEDURE

1. Record the radio station presets.

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

2. Refer to the owner's or service manual. Does the vehicle you are working on have a security system on the radio?

_____

Note: *If the vehicle does have a security system installed on the radio you may need to reinitialize the system or enter a code following a battery disconnect. Refer to the service manual for instructions on retrieving and entering the code.*

3. Install the memory saving device.

Note: *Some memory saving devices are installed in the cigarette lighter and others use the battery terminals.*

Task Completed _____

Figure 27.10 A tool for keeping computer memory alive while a battery is removed for service.

4. Remove the battery negative cable.

Task Completed _____

5. Remove the battery positive cable.

Task Completed _____

6. Remove the battery holddown apparatus.

Task Completed _____

7. Clean the battery holddown, tray, and cables as needed.

Note: *See Job Sheet #42 for the procedures for cleaning.*

Task Completed _____

8. Reinstall the battery and holddown apparatus.

Task Completed _____

9. Connect the positive cable to the battery.

Task Completed _____

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

10. Connect the negative cable to the battery.

Task Completed _____

11. Remove the memory saving device. Did the memory saving device work?

_____

12. If the memory saving device did not work, you will need to set the radio station presets, clock(s), and seat memory positions.

Task Completed _____

Problems Encountered

_____

_____

_____

INSTRUCTOR EVALUATION

- ☐ 4 Mastered Task
- ☐ 3 Able to Perform Task Independently; Some Additional Training Suggested
- ☐ 2 Able to Perform Task with Close Supervision; Requires Additional Training
- ☐ 1 Unable to Perform Task
- ☐ 0 Not Attempted

Comments

_____

_____

Instructor Name: _____ Date: _____

Instructor Signature: _____

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

JOB SHEET 48

Identifying Hybrid Electric Vehicle High-Voltage Circuits, Safety, and Precautions

Name: _____ Station: _____ Date: _____

NATEF Correlation

This Job Sheet addresses the following NATEF task(s):

6.B.7 Identify high-voltage circuits of electric or hybrid electric vehicle and related safety precautions. (P-3)

6.B.9 Identify hybrid vehicle auxiliary (12v) battery service, repair, and test procedures. (P-3)

8.F.7 Identify hybrid vehicle internal combustion engine service precautions. (P-3)

Performance Objective(s)

Upon completion of this Job Sheet, you will be able to describe how to safely handle and identify a hybrid electric vehicle and related components.

Tools and Materials

Service manual

High-voltage gloves

Protective Clothing/Equipment

Goggles or safety glasses with side shields

Describe the vehicle being worked on:

Year	Make	Model	VIN	Engine type and size

PROCEDURE

1. Describe the location of the high-voltage service plug (also known as the disconnect plug).

_____

_____

2. Gain access to the service switch.

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.

3. Compare those readings to what the manufacturer specifies. Is there a difference?

_____

4. Do the pressure readings indicate that the warning light should be on?

_____

5. Gain access to the service manual. Describe how this specific type of TPMS works.

_____

_____

Task Completed _____

Problems Encountered

_____

_____

_____

INSTRUCTOR EVALUATION

- ☐ 4 Mastered Task
- ☐ 3 Able to Perform Task Independently; Some Additional Training Suggested
- ☐ 2 Able to Perform Task with Close Supervision; Requires Additional Training
- ☐ 1 Unable to Perform Task
- ☐ 0 Not Attempted

Comments

_____

_____

Instructor Name: _____ Date: _____

Instructor Signature: _____

© 2012, Cengage Learning, Inc. Licensed for one-time use by the purchaser only; no additional copying or retransmission is permitted.